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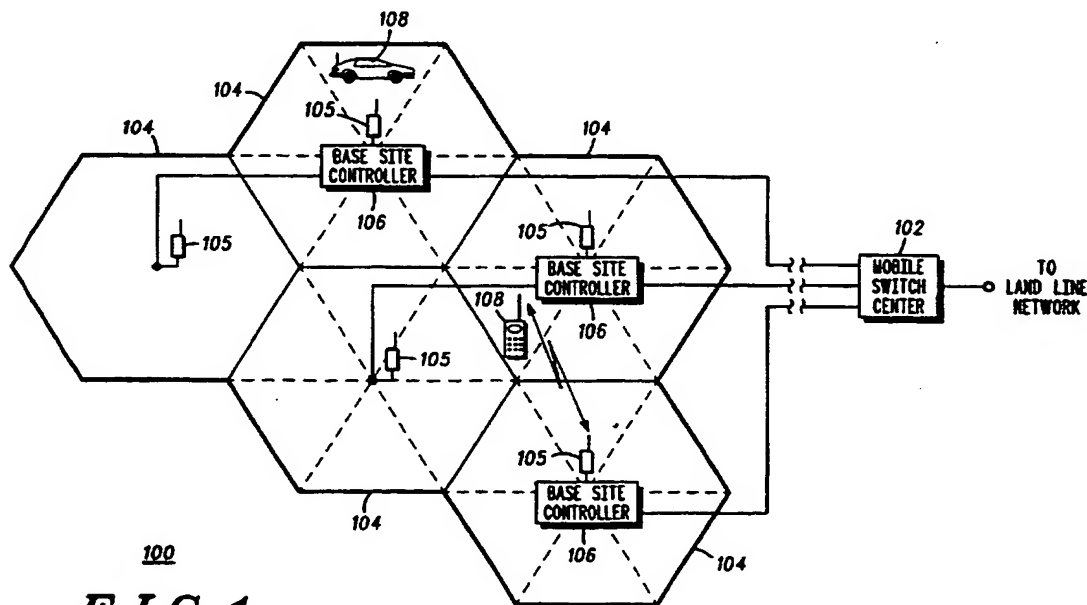
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GB 2294844 A WO 95/10152 A1 US 5343513 A

(58) Field of Search

UK CL (Edition N) H4L LDSC LDSE**INT CL⁶ H04Q 7/00 7/20 7/22 7/30 7/36****ONLINE: WPI, INSPEC**(54) **Base Site Controller and System Selection Method**

(57) A base site controller (106) includes a transmitter (340), a receiver (342) and a controller (344). The controller (344) is coupled to the transmitter and receiver and operative to select and activate systems based upon demand from active or potential subscriber units for systems that the base site controller is able to support. Examples of such systems include GSM, ETACS, US analogue, USDC, NAMPS, DCS 1800 and the Nordic systems. Communication resources are allocated among active systems according to demand.

**FIG. 1**

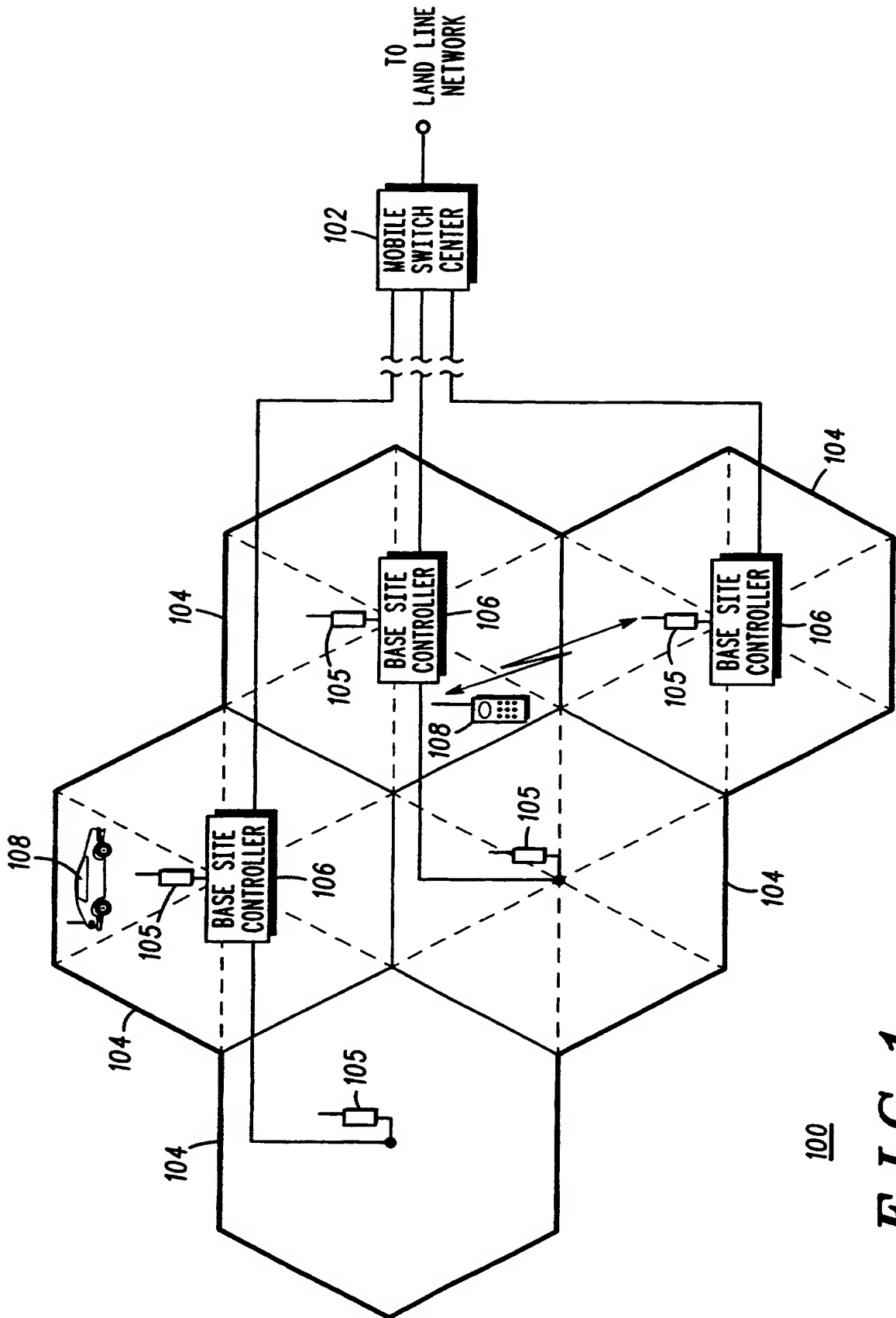


FIG. 1

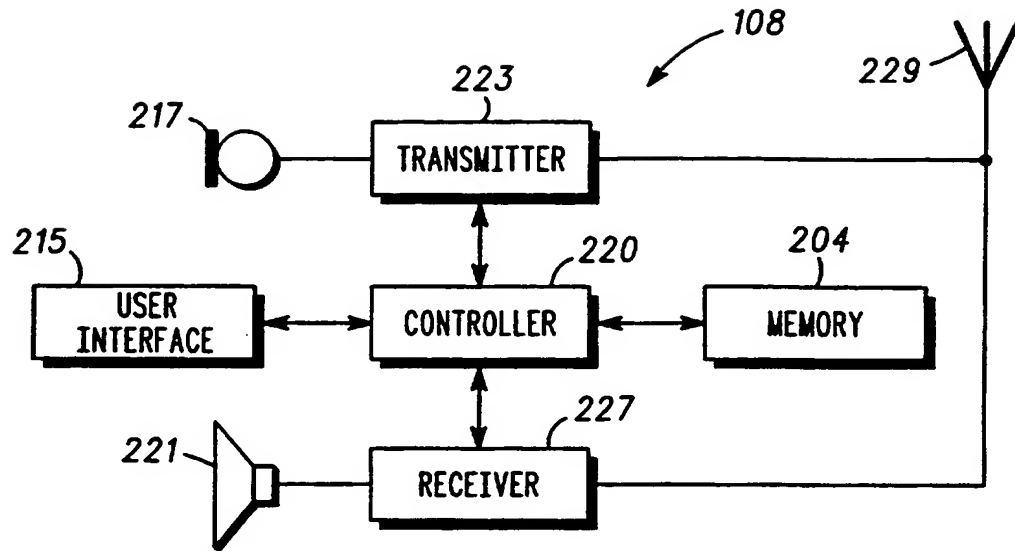


FIG. 2

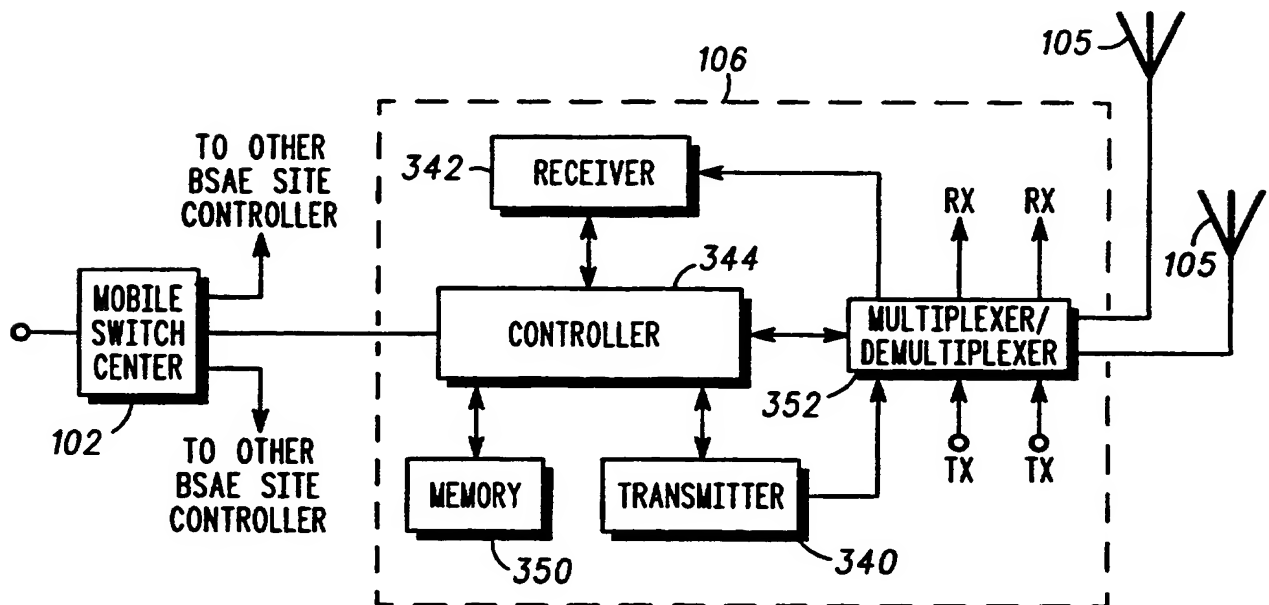
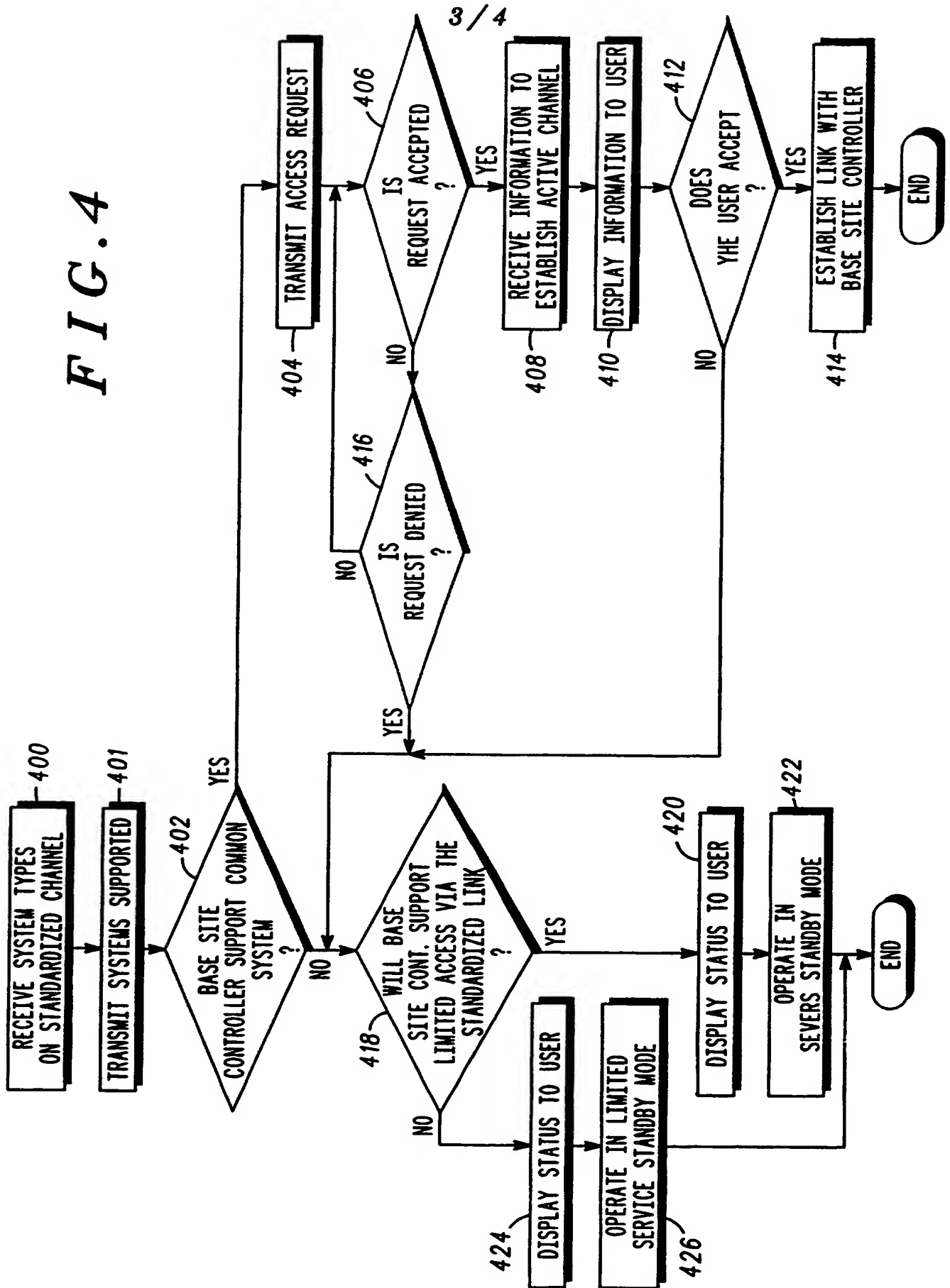
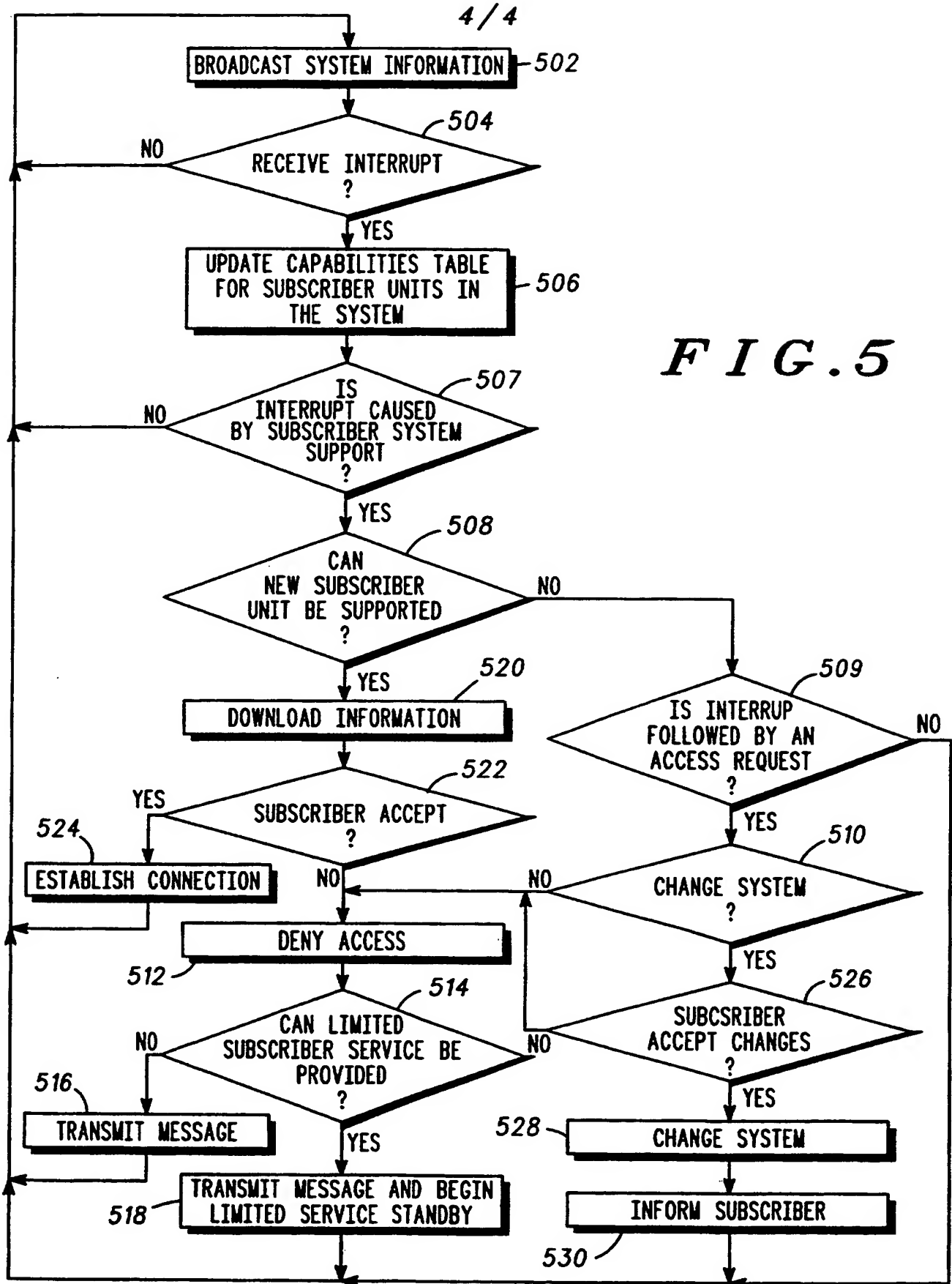


FIG. 3

FIG. 4





BASE SITE CONTROLLER AND SYSTEM SELECTION METHOD

Field of the Invention

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The present invention pertains to cellular systems and more particularly to system selection.

Background of the Invention

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Wireless communication devices communicate with other devices that are compatible therewith. In the case of cellular radiotelephones, subscriber units communicate with bases supporting the same communication system. Subscribers purchase units that support a service provider's wireless infrastructure in a geographic area where the subscriber expects to use the subscriber unit. This geographic area is commonly known as the subscriber's "home zone." However, subscribers do not remain in their home zone at all times. When a subscriber's radiotelephone is active or in standby mode when the subscriber moves to an area outside of their home zone, they are "roaming."

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A roaming subscriber unit must access some service provider's infrastructure to make or receive a call. However, service providers in different geographic areas have infrastructure supporting different wireless systems. Examples of such systems include Global System for Mobile Communications (GSM), European Telephone Analogue Cellular Telephone System (ETACS), United States (US) analogue, United States Digital Cellular (USDC), Narrow band Analogue Mobile Phone System (NAMPS), Digital Cellular System (DCS) 1800, and the Nordic systems. Different systems are used in different areas for a variety of reasons, including government regulations, compatibility with systems in adjacent service areas, and service provider preferences.

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A difficulty encountered in attempting to access infrastructure for different systems is that radiotelephones for one system will not operate with infrastructure for another system. Consequently a radiotelephone will not

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always operate when the subscriber is travelling. When a service provider has radiotelephones in his service area that he can not support, the service provider loses potential revenue because these subscribers will not be able to use his service to make calls. It is also disadvantageous to the subscribers who want(s) to use their radiotelephones when they travel that they can not use it when they travel into an area having incompatible infrastructure.

One solution is to provide radiotelephones having multiple modes of operation, wherein each mode is for a different system. Thus, for example, in the United States, dual mode phones provide both digital and analogue service. A dual mode digital/analogue radiotelephone that operates in its digital home zone automatically operates in a US analogue mode when the radiotelephone roams into an area having US analogue coverage. This allows the radiotelephone to adapt to the coverage area in which it is located. A limitation of this arrangement is that the service provider's ability to service travelling subscriber units is dependent upon the ability of the roaming subscriber units to adapt to the service provider's system.

Service providers can provide infrastructure that supports different systems. This can be accomplished by the service provider installing separate infrastructure throughout its coverage area to support each of the systems, such as by providing both analogue and a digital cellular system infrastructure. However, the cost of providing dual infrastructure is very high, and might only be cost effective in very high volume areas. Additionally, some systems will conflict with one another. Conflicting systems have overlapping frequency bands and employ signal formats that cause interference with one another such that they can not operate in the same coverage area at the same time.

Accordingly there is a need for an improved system to better accommodate roaming subscriber units.

Summary of the Invention

A base site controller includes a transmitter, a receiver, and a controller. The controller is coupled to the transmitter and receiver and is operative to

select and activate systems based upon demand for systems that the base site controller is able to support.

A method of controlling the base site controller is also set forth.

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By selecting a system based on demand, the base site controller can accommodate subscriber units in a manner that maximises revenue for the operator and continues service to home subscribers.

10 Brief Description of the Drawings

FIG. 1 illustrates a cellular communication system.

15 FIG. 2 is a circuit schematic partially in block diagram form and illustrating a subscriber unit in the system according to FIG. 1.

FIG. 3 is a circuit schematic in block diagram form illustrating a base in the system according to FIG. 1.

20 FIG. 4 is a flow chart illustrating operation of a base site controller in the system according to FIG. 1.

FIG. 5 is a flow chart illustrating operation of a subscriber unit in the system according to FIG. 1.

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Detailed Description of the Preferred Embodiment

A communication system 100 (FIG. 1) includes wireless communication bases communicating with a mobile switch centre 102. The mobile switch
30 centre is connected to a landline network. The wireless communication bases include a base site controller 106 and antenna system 105. The mobile switch centre 102 interconnects base site controllers 106 for communications therebetween and for communicating with the land-line network. The base site controllers 106 are connected to antenna systems 105 that cover
35 respective cells 104. A cell is the coverage area of any one of the antenna systems 105. The antenna systems 105 can be a single antenna, a group of

antennas wherein each antenna in the group covers a different sector of the cell, antenna arrays each covering a sector of the cell, or any other suitable antenna structure. Groups of cells are clusters. The area covered by an operator's clusters is the operators coverage area.

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The wireless communication base can be a cellular telephone base station, a communication satellite, a radio dispatch centre, or the like. However, it will be described herein as a radiotelephone base for brevity.

- 10 Those subscriber units 108 compatible with the base site controller 106 are able to operate while they are within the coverage area of at least one of the antenna systems 105. The subscriber units 108 are able to communicate with the land-line network through the base site controller 106 and the mobile switching centre 102.

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- The subscriber units 108 are illustrated to be portable cellular radiotelephones and vehicle mounted cellular radiotelephones. However, these subscriber units can be any suitable wireless device that operates with a base, and may for example be a cellular radiotelephone, such as a portable
20 radiotelephone, a transportable radiotelephone, or a vehicle radiotelephone, a wireless modulator/demodulator (modem) of the type connectable to a computer, a personal digital assistant including a wireless transceiver, a two-way radio, or any other standard radio frequency device supporting wireless communications.

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- The subscriber units 108 include a transmitter 223 connected between a microphone 217 (FIG. 2) and an antenna 229. A receiver 227 is connected between antenna 229 and a speaker 221. A controller 220 is connected to transmitter 223, receiver 227, a memory 204, and a user interface 215. The
30 user interface includes a display (not shown) and a keyset (not shown). Memory 204 stores operating programs for the subscriber unit 108, information about the operating modes for the subscriber unit, and status information. Signals generated by input to transmitter 223 are communicated via antenna 229 to base site controller 106. Signals input to
35 receiver 227 are output to speaker 221 and controller 220. The transmitter 223 and receiver 227 are implemented using any suitable conventional radio

frequency wireless communication circuitry. The controller 220 can be implemented using a programmable logic unit, a digital signal processor, a microprocessor, or the like. The memory is implemented using read only memory (ROM), random access memory (RAM), electronically erasable programmable read only memory (EEPROM), a combination thereof, or the like.

The base infrastructure consists of antenna systems 105, base site controller 106, and mobile switch centre 102. The mobile switch centre can be implemented using any suitable conventional switching circuitry.

The base site controller 106 includes a transmitter 340 and a receiver 342 connected to a controller 344. The controller 344 communicates with the mobile switching centre 102. The transmitter 340 and receiver 342 are connected to antenna systems 105 via multiplexer/demultiplexer circuit 352. The multiplexer/demultiplexer circuit 352 routes signals between receive (RX) and transmit (TX) paths associated with different transceivers and the transceiver antenna systems 105.

A memory 350 is connected to controller 344 and stores system information and information about devices requesting access thereto. The memory may be an electronically erasable programmable read only memory (EEPROM), a random access memory (RAM), a hard drive, or any other suitable memory device. The controller 344 can be implemented using a microprocessor, a computer, a DSP, a PLU, or the like.

The base site controllers 106 and the subscriber units 108 support a standardised channel including an up link to the base site controller 106 and a down link from the base site controller 106. The standardised channel is usable by all subscriber units 108 and base site controllers 106 regardless of the type of system for which they support full service communications. The base site controller 106 broadcasts information about the systems supported by the base site controller on the standardised down link. A portion of this standardised down link channel is reserved for communicating directly with mobile radiotelephones that have requested access and have been denied such access. This allows limited signalling which may be used to monitor

the subscriber units 108 and/or to provide the non-active mobiles with very limited service.

5 The operation of the subscriber unit 108 controller 220 will now be described with reference to FIG. 4. The controller 220 reads the standardised down link channel to identify the systems supported by the base site controller 106 in the cell 104 in which it is located, in block 400. The controller 220 transmits the identity of the systems that it supports, in block 401. Alternatively, a programmable subscriber unit could send information on its capability to enable the base site controller 106 to determine which systems the subscriber unit can support. The block 401 is thus optional, and can be omitted. The controller 220 then determines if the base site controller 106 and subscriber unit 108 support a common system from the information received from the base site controller 106, in decision block 402. If they do not, the controller 220 enters the standby mode at block 418.

If the broadcast indicates that the base site controller 106 and the subscriber unit 108 support a common system, as determined in block 402, the subscriber unit 108 controller 220 requests access to the base site controller via the up link of the standardised channel, as indicated in block 404. The controller 220 then determines if the request is accepted or denied, in decision block 406. If the requested system is currently active, the subscriber unit 108 will receive the information, such as the control channel frequencies and any enabling software, necessary to access the system and the connection or air time costs. This cost information is displayed to the user in block 408. The controller 220 then waits a predetermined time period for the user to accept the rates, in decision block 412. If the user accepts the rate in the predetermined time period, for example by pushing an "enter" or "OK" key on the keyset, the connection to the base site controller 106 is established in block 414. The subroutine then ends. If the subscriber does not accept the rates within the predetermined time period, the controller 220 proceeds to the standby mode at block 418.

35 If the request is not accepted, as determined at block 406, the controller 220 determines if access is denied in decision block 416. If the access is not denied, the controller returns to block 406 to await acceptance or denial. If

the access is denied in block 416, the controller 220 enters the standby mode in block 418.

5 The controller 220 determines in decision block 418 whether the base site controller 106 will support limited services in the standby mode. Such limited services can include subscriber unit monitoring, short message service (SMS), electronic mail messaging, or other services. If the limited services are not available, the status is displayed to the user via user interface 215, as indicated in block 420. The controller 220 then enters the severe standby mode in block 422, and the subroutine ends. The severe standby mode is a severe battery saving mode, wherein the controller is shut down for a predetermined time period and interrupted at the end of the time period to reexecute this subroutine. If the base site controller 106 will support limited services, the controller 220 displays a message to the user on a display in the user interface 215, in block 424. The controller 220 then enters the limited service standby mode of operation waiting for messages provided by the limited services available on the standardised channel and participating with the base site controller 106 in monitoring the subscriber unit 108 to determine if the previously requested system becomes available at a later time, in block 426.

25 Thus if the subscriber unit 108 is capable of operating with a currently active system of base site controller 106 or is granted access to a new active system, then the subscriber unit is configured for that system. In all other cases, the subscriber unit 108 is denied full service.

30 The controller 344 in base site controller 106 performs a number of functions at pre-determined intervals. The predetermined intervals may be any suitable time period, such as every five minutes, every hour, or any other desired time period. The controller 344 of base site controller 106 controls transmitter 340 to broadcast information about the systems that it supports, in block 502 (FIG. 5). The controller 344 waits for an interrupt in block 504. The interrupt will occur upon receipt of system support information 401 from an unrecognised subscriber unit. Alternatively, the interrupt could be caused by a subscriber unit requesting access. Either of these will occur when a subscriber unit arrives or is switched on within coverage of a base

- site controller. Upon leaving the coverage area of a base site controller, or when being switching off, the subscriber unit registers its departure using the standardised signalling channel or through the system, if the subscriber unit was active. Registering the departure of the unit also causes an
- 5 interrupt detected at block 504. An interrupt will occur whenever the controller 344 needs to update memory 350 for a change in the system. Block 502 can be omitted if it is not desired to broadcast system information to subscriber units.
- 10 The controller 344 updates the stored information of capabilities of the subscriber units 108 within its coverage area, in block 506. The subscriber capabilities are stored in memory 350. This information is used by the base site controller 106 to assess demand and to determine the requirements of
- 15 roaming users, for each system that it offers. An example of a system demand assessment stored in memory 350 is given below in table 1.

Table 1

Device Sys. Type	A	B	C	D	
Mobile No.					Device Type
1	0	1	1	0	Dual mode
2	1	1	0	0	Dual mode
M	M	M	M	M	
N	0	1	0	0	Single mode
Totals	25	40	30	2	

- 20 The number of users N will vary over time as subscriber units enter and exit the coverage area of a base site controller. The types of services that A-D can have, as an example, include ETACS, GSM, DCS 1800 and US analogue. The base site controller 106 will determine the number of subscriber units that are currently active, on standby but can support at least one of the
- 25 systems that the structure can support, and that are requesting access via the base site controller 106. Additionally, Table 1 includes all of the systems supported by each such subscriber units. The controller tries to have active the system or systems offering the maximum number of subscribers with coverage.

The controller 344 determines if the interrupt was caused by receipt of a signal including the systems that a subscriber unit 108 can support, in decision block 507. Such a message will arrive prior to a request for service, and thus the controller must process the impending request. If the interrupt is caused for some reason other than an impending request for access, the controller 344 will return to block 502 and await the next interrupt. This allows Table 1 to be updated when subscriber unit status changes. It will be recognised that if the subscriber unit 108 does not transmit the support message prior to an access request, the controller 344 will proceed to decision block 508 responsive to this access request. This allows a subscriber access request to be processed at any time.

The controller 344 determines whether the new subscriber unit can be supported, in decision block 508. If the subscriber unit 108 requesting access supports a system that can not be supported by base site controller 106, either because the system is not active or because it is fully loaded, the controller 344 determines whether to change the system in decision block 510. Numerous factors must be considered by the controller 344 in making this decision.

These considerations include spectrum availability for both active systems and potential systems. Where the communication system 100 is capable of supporting multiple systems, it is envisioned that the demand for each combination of systems can be monitored and the available system resources shared in such a way to optimise revenues by maximising the total number of users. For example, where there are two systems operational in a common frequency range, or spectrum, the system can provide frequency division sharing between these systems. Thus, the controller 344 can decide to assign more spectrum resources to a system with high demand if the spectrum resources are available, or if the spectrum can be made available, for example, by removing some spectrum from another currently active system. Alternatively time division sharing of the spectrum or code division sharing of a particular spectrum can be employed. Time division sharing is accomplished by activating each of the systems sequentially, and leaving them on for a predetermined time period. During intervals when a

subscriber unit can not use the system, it will have limited services in the limited service standby mode.

Where a subscriber unit 108 requests access on a system that is not
5 currently active and which operates in different spectrum than the system or
systems currently active in a cell 104, and such spectrum is available in cell
104, the base site controller 106 can activate the new spectrum without
affecting the spectrum of the currently active system. This might be the
case if a new user requests operation at 1.9 GHz when the currently active
10 system is GSM. These systems operate at widely spaced frequencies, such
that the base site controller 106 can activate the 1.9 GHz system without
interfering with signals in the GSM spectrum.

Where an active system and a requested, but not currently active, system
15 can operate on the same or overlapping spectrum, then if the active system
in the vicinity of the subscriber unit 108 is not fully loaded, it may be
determined that some spectrum could be taken from the active system in
this vicinity to provide resources for a new system. The demand assessment
information stored in memory 350 is used by the controller 344 to determine
20 if spectrum should be made available to provide a new system. Otherwise
the requested system can not typically be added with the active system.

The standardised channel can include a broadcast of an invitation to register
with the infrastructure through the standardised channel, even if the
25 infrastructure does not support the subscriber's system at that time. The
infrastructure includes antenna system 105, base site controller 106, and
mobile switch centre 102. By registering the radiotelephones, the base site
controller 106 can keep track of how many radiotelephones would be
supported for each possible system. For most services, such as voice
30 services, the subscriber unit 108 can be considered to be in the inactive state
in this limited service mode. If the demand reaches a threshold, when the
controller 344 decides to change the system, it can inform those subscribers
in the minimal level of service state that the new system or resources are
available, in block 530. The availability of a new service will be indicated to
35 the user by the subscriber unit.

Home subscriber units of the operator will be heavily favoured. Home subscriber units are subscriber units operating in their home zone.

The controller 344 preferably includes a home zone use threshold. The home zone use threshold is the threshold at which the controller 344 will

5 shut off the home zone service, which is the basic system of the operator. For example, the system operator may have a system that it provides access on to low use subscribers. These subscriber's have subscriber units operational in only one system, which is a base system common to all of the service provider's subscribers. Higher level users will have subscriber units

10 that operate in a large number of systems, including the base system. Before the operator will turn off the base system, the number of low use home subscribers must be less than the home zone threshold. It is envisioned that the base system will use a home zone threshold of one. That is, if one home subscriber requires the base system, then the base system will be active. If

15 the home subscriber unit requesting the base system will also operate on another system, such other system can be selected in lieu of the base system. In either case, home subscriber's will get preferential treatment.

It will be recognised that the home zone threshold may be other than 1.

20 Thus, a service provider could allow for home subscribers to not have service if a sufficient amount of revenue would be lost. In this case, the threshold will require that substantially more money be generated by roaming users than home subscribers. The home zone threshold is then set as a function of roaming tariffs.

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An additional consideration can be the potential loading by the carrier's home subscribers. If the use patterns are such that home subscribers are likely to well load the base site controller 106, then the number of potential roaming users for the base site controller 106 will have to exceed a large

30 number before the expected total revenue increase by serving the roamers justifies the inconvenience to the home system users. The threshold for potential users in a heavy home use area will have an activating threshold set very high. If the home subscriber load is expected to be low, then the threshold at which roaming subscribers will get access can be set low. It will

35 also be recognised that potential peak loading characteristics can be factored in when determining the threshold at any particular time.

For roaming subscriber units, those subscriber units that are operated by heavy users will be treated preferentially relative to subscriber units operated by light users. Thus, a subscriber who utilises their radiotelephone extensively will be more heavily weighted than a subscriber who rarely utilises their cellular phone. For example, a heavy user may count as four subscriber units whereas a light user may count as a single subscriber unit. The requesting radiotelephone device's use pattern is determined from the home location register (HLR) of the requesting mobile subscriber devices, which stores information about subscriber use patterns.

An example implementation is described hereinafter. The example system has three systems, resource 1, resource 2, and resource 3, each of which can be supported by the base infrastructure. The basic system for home subscribers is resource 1, having home subscriber demand h_1 . Of these h_1 home subscribers, j subscribers are determined to be low end users, such that they can only use resource 1. The ratio of roaming tariff to home user tariff is K . The average acceptance rate of roamers for this tariff is t . The n 'th roamer usage weight is w_n , heavy users having a higher weight than light users. The home zone threshold is q . Table 1 is represented by a matrix X with N rows and 3 columns, where N is the number of subscriber units and the first h_1 rows are for home users. To simplify, it is assumed that a maximum demand "max_demand" can be supported no matter which systems are used, and that each system has a minimum capacity of 1. Assigning i_1 to equal 1 indicates that resource 1 is active; assigning i_1 to equal 0 indicates that resource 1 is inactive. Similarly i_2 and i_3 indicate the activity of resources 2 and 3 respectively.

Then the resources assigned to each system are determined as follows:

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30 resource(1)=0           ) This sets the initial values to
   resource(2)=0           ) 0 for resource (1), resource
   resource(3)=0           ) (2), resource (3) and
   max_rev=0               ) maximum revenue.
35 do i1=0,1               ) Each system is enabled for

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do i2=0,1                                ) a trial period.
do i3=0,1

demand_tot=0
5  flag=1
   rev_tot(i1,i2,i3)=0                    ) The total revenue for a trial
                                           ) is initially set to 0.

   if i1 = 0                              ) If base system is disabled, see if
10      if j>=q then flag=0                ) home users are still supported.
                                           ) If unsupported low-end home users
                                           ) exceed home zone threshold then the
                                           ) trial failed (the system won't change).

15      if flag=1                          ) See if high-end users are supported.
                                           ) If number of unsupported low-end
                                           ) plus high-end home zone users
                                           ) exceeds the home zone threshold,
                                           ) then the trial has failed.

20      n_unsupp_home=0
      do n=j,h1
          if (X(n,2)=1 and i2=0) or (X(n,3)=1 and i3=0) then
              n_unsupp_home=n_unsupp_home+1
          end do
25      if n_unsupp_home >= q-j then flag=0
      end if
end if

   if flag=1                              ) If the min_number of home users
30      ) are supported, then the number of
      ) potential subscriber units for each
      ) of the systems is determined.

                                           ) Firstly, subscriber units are assigned
35      ) to candidate active systems.

      do n=1,N

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if X(n,1) = 1 and i1=1 then assign(n)=1
else if X(n,2) = 1 and i2=1 then assign(n)=2
else if X(n,3) = 1 and i3=1 then assign(n)=3
else assign(n)=0          ) The unit is not assigned.
5   end do

n=0
while demand_tot < max_demand    ) So long as the total
    n=n+1                        ) demand less than maximum
10   if (n > h1) then p=K*t else p=1 ) calculates expected
    if (n > h1) then c=t else c=1   ) revenue for home
    if (n > h1) then c=t else c=1   ) zone and roaming
    if (n > h1) then c=t else c=1   ) units from each
15   if (n > h1) then c=t else c=1   ) system. Units are
    if (n > h1) then c=t else c=1   ) weighted according
    if (n > h1) then c=t else c=1   ) to their historical
    if (n > h1) then c=t else c=1   ) usage.

20   if (assign(n)>0) then
        demand_tot=demand_tot+wn.c
        rev_tot(i1,i2,i3)=rev_tot(i1,i2,i3)+wn.p
        resource(assign(n))=resource(assign(n))+wn.c
    end if
25   continue while
end if

if (rev_tot(i1,i2,i3) > max_rev)    ) Each system trial has an index,
    max_rev=rev_tot(i1,i2,i3)       ) and the index of the trial
30   if (rev_tot(i1,i2,i3) > max_rev) ) having the highest revenue is
    if (rev_tot(i1,i2,i3) > max_rev) ) selected to select the systems.
    if (rev_tot(i1,i2,i3) > max_rev) ) For example, index=[1,0,1]
    if (rev_tot(i1,i2,i3) > max_rev) ) means that the systems 1 and 3
    if (rev_tot(i1,i2,i3) > max_rev) ) are active.

35   index=[i1,i2,i3]
end if

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$z = \text{resource}(1) + \text{resource}(2) + \text{resource}(3)$

$\text{rel_res}(i1, i2, i3) = [\text{resource}(1)/z, \text{resource}(2)/z, \text{resource}(3)/z]$

5) The systems are allocated as
) permitted by the total capacity of
) the infrastructure. For example,
) $\text{rel_res} [.7, .3, 0]$ means
) that resource 1 will have 70%
 10) of the spectrum and resource 2 will
) have 30% of the spectrum where the
) total capacity of the system is
) allocated by dividing the spectrum.

end do
 15 end do
 end do

The preferred relative resource assignment is then given by $\text{rel_res}([\text{index}])$.
 The $\text{rel_res}(i1, i2, i3)$ is the fraction of the available capacity of the base site
 20 controller 106 given to each resource, and can be by frequency separation,
 time separation, code separation, or the like.

Before changing systems, the controller 344 determines whether the last
 subscriber unit 108 requesting access will accept payment, both in high
 25 minute charges and possibly a high access fee, in block 526. The fee charged
 for accessing the system may be substantially higher if only a very few users
 wish to utilise a system that is not currently active. If not, access is denied.
 If yes, then the controller changes the system, in block 528, informs
 subscriber units, in block 530, and ends.

30
 Where each of the system is supported by equipment dedicated to a single
 system, the system change is made by deactivating equipment dedicated to
 one system and activating equipment dedicated to another system. For
 example, a different base site controller 107 and antenna system 105 can be
 35 located in the same cell and individually activated. Alternatively, equipment
 can be shared by more than one system and operating software can be

changed to support different systems. For example, where resources are to be increased in an already active system, software or control parameters can be changed to alter support in the system.

5 It will be recognised that upon changing the system subscriber units involved in a call are instructed to hand-off to a new channel, either within the same system if a resource modification is taking place, or to a new system. Registered but not active subscribers are told to reregister if they are to use a new system.

10

If the subscriber unit could be supported by a currently active system, as determined in decision block 508, the information necessary for the subscriber unit to operate is downloaded to the subscriber unit, in block 520. This information includes frequency information, tariff information,

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software or other specification information to allow the subscriber units to access the system. The controller 344 then waits for the subscriber unit 108 to accept the rates in block 522. If the subscriber unit 108 accepts the rates, the connections are established in block 524, and the subroutine returns to block 502. If the subscriber does not accept the rates, then the controller 344

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proceeds to block 514.

If the system could not be changed, as determined at block 510, or the subscriber unit does not accept the charges, as determined in block 522, then the controller denies access, as indicated in block 512. In decision block 514, 25 the controller 344 determines whether the requesting subscriber unit can be supported on limited standby services. If the user can not be supported, a message is transmitted to the subscriber unit indicating that service can not be supported, in block 516. If the user can be supported, then the controller proceeds to block 518, wherein a signal is transmitted indicating that the 30 user will be supported in a limited service standby mode.

In the limited standby mode, the base site controller 106 provides a minimal level of service to each subscriber unit 108 in its cell using the standardised channel. This allows messaging to be provided to the radiotelephones within 35 a service provider's coverage area via the standard channel. Additionally, mobile management at a minimal level can be supported.

It is envisioned that the standardised channel can be utilised for authentication of the subscriber unit 108 and other housekeeping chores of the communication system 100. Alternatively, authentication can occur
5 when accessing the active system of base site controller 106

Accordingly, it can be seen that a more versatile system of supporting roamers can be provided. The system maximises the usefulness of the a base station to multiple roamers and thereby maximises the ability of the service
10 provider to generate revenue.

CLAIMS

1. A method of operating a wireless communication base to dynamically support systems based upon subscriber unit demand in a base coverage area, comprising the steps of:
- 5 determining the subscriber unit demand for services;
ascertaining spectrum availability from current usage and demand of the wireless communication base; and
allocating resources based upon the demand and spectrum availability, wherein the step of allocating includes determining whether to support a particular system and changing the system supported by the wireless communication base according to the demand and spectrum availability.
- 10
2. The method as defined in claim 1, wherein the resources are allocated between different active systems are adjusted according to demand.
- 15
3. The method as defined in claim 1, further including the step of providing a standardised channel by which subscriber units can communicate with the wireless communication base even if a system supported by the subscriber units is not active in the wireless communication base.
- 20
4. The method as defined in claim 1 or 3, wherein the wireless communication base determines the capabilities of each subscriber unit in its coverage area in assessing demand and determines which system will service the most subscriber units and instructs the subscriber units to use the system that support the most users.
- 25
5. The method as defined in claim 3 or 4, further including the step of receiving and processing the capabilities of subscriber units requesting access on the standardised channel.
- 30

6. The method as defined in claim 1, 3, 4 or 5 further comprising the step of assessing demand due to home subscribers and roaming subscriber units.

5 7. The method as defined in claim 1, wherein subscriber units that are known to make many calls are weighted more heavily than those used infrequently.

8. The method as defined in claim 1 or 6 wherein home
10 subscribers are treated preferentially.

9. The method as defined in claim 1, 6 or 8, further including the step of establishing a predetermined threshold which the number of roaming subscriber units must exceed relative to home subscribers before activating a
15 new system.

10. The method as defined in claim 1, 6 or 8, further including the step of establishing a predetermined threshold at which the number of subscribers denied access must not be exceeded.
20

11. The method as defined in claim 1, 6,7 or 8, wherein the wireless communication base provides different systems sequentially at different times for respective non-overlapping time intervals.

12. The method as defined in claim 1, wherein when initially accessing the system to indicate its capability, the wireless communication base requests that requesting subscriber units register therewith even though the wireless communication base does not support a system compatible with the requesting subscriber units such that the wireless
25 communication base can keep track of how many subscriber units would be supported for each possible system for use in enabling and disabling specific systems.
30

13. A method of operating a subscriber unit, comprising the steps of:
35 determining if a system is available that the subscriber unit is able to support,

requesting limited services through a standardised channel if the system and the subscriber unit will not support a common channel; and if denied, entering a severe battery saving mode, where from time to time it will request access through the standardised channel.

5

14. The method as defined in claim 13 wherein the limited services include short messaging.

15. The method as defined in claim 13 wherein the limited services include an indication from infrastructure that a new system is available.

10

16. The method as defined in claim 13 or 14 wherein the subscriber unit requests service via the standardised channel and indicates which systems it is capable of supporting.

15

17. The method as defined in claim 13 or 14 wherein the subscriber unit requests access via the standardised channel and identifies the address of a home location register containing information about the systems that the subscriber unit is able to support.

20

18. The method as defined in claim 13, wherein if the subscriber unit is sufficiently capable of operating with a currently active system, configuring the subscriber unit for the currently active system.

25

19. A base site controller comprising:

a transmitter;

a receiver;

a memory; and

a controller coupled to the transmitter, the receiver, and the memory,

30 the memory storing information associated with different systems and information about active or potential subscriber units, the controller operative to select and activate system based upon demand for systems that the base site controller is able to support.

20. A base site controller as defined in claim 19, wherein the controller allocates resources between different active systems and adjusts the allocation according to demand.

5 21. A base site controller as defined in claim 19 or 20, wherein the controller activates or adjusts systems by software control.

10 22. The base site controller as defined in claim 19, wherein the base site controller weights subscriber units according to historical usage, such that heavy use subscriber units are more heavily weighted than light use subscriber units.

15 23. The base site controller as defined in claim 19, wherein the controller has a home subscriber threshold which requires very heavy use by roaming users before a system supporting home subscribers is deactivated.

 24. A base site controller substantially as herein before described with reference to the accompanying drawings.

20 25. A subscriber unit controller substantially as herein before described with reference to the accompanying drawings.

25 26. A method of operating a base site controller substantially as herein before described with reference to the accompanying drawings.

 27. A method of operating a subscriber unit substantially as herein before described with reference to the accompanying drawings.



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Claims searched: 1-12, 19-23

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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK CI (Ed.O): H4L (LDSC, LDSE)
Int CI (Ed.6): H04Q 7/00, 7/20, 7/22, 7/30, 7/36
Other: Online: WPI, INSPEC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2294844 A (MOTOROLA)	
A	WO 95/10152 A1 (MOTOROLA)	
A	US 5343513 (KAY)	

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